IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

Appellants:	Voelkel et al.
Serial No.:	10/599,879
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For:	Device, Sensor Arrangement and Method for the Capacitive Position Finding of a Target Object
Dkt. No.:	WEBE-0021
Conf. No.:	5955
Examiner:	Valone, T.
Art Unit:	2831

Mail Stop Appeal Brief - Patents
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BRIEF OF APPELLANTS

This is an appeal from the Final Rejection dated July 28, 2010, rejecting claims 19-40. This Brief is accompanied by the requisite fee set forth in 37 C.F.R. 1.17 (c).

REAL PARTY IN INTEREST

Pepperl + Fuchs GmbH is the real party in interest.

RELATED APPEALS AND INTERFERENCES

There are no related appeals or interferences.

STATUS OF CLAIMS

As filed, this case included claims 1-18. Claims 1-18 were cancelled and claims 19-40 were added. Claims 19-40 remain pending, stand rejected, and form the basis of this appeal.

STATUS OF AMENDMENTS

A response has not been filed in response to the Final Office Action dated July 28, 2010.

SUMMARY OF CLAIMED SUBJECT MATTER

The invention as presented in independent claim 19 provides a device (see, e.g., device 10, FIG. 1; paragraph bridging pages 13-14) for the capacitive position finding of a target object (see, e.g., target object 12, FIG. 1; paragraph bridging pages 13-14) having a plurality of capacitive probes (see, e.g., capacitive probes 20, 30, 40, FIG. 1; paragraph bridging pages 13-14; first and last full paragraphs on page 14) distributed over a detection area in which a position of the target object is to be determined, wherein a dependence of the probe voltages on the spacing of the target object from the given capacitive probe is evaluatable for position determination (see, e.g., last full paragraph on page 14), the probes are in each case connected across coupling capacitances (see, e.g., coupling capacitances 22, 32, 42, FIG. 1; paragraph bridging pages 13-14) to a voltage supply (see, e.g., voltage source 14, FIG. 1; paragraph bridging pages 13-14) and can be supplied with a supply voltage, the

capacitances of probes to the environment (see, e.g., measurement capacitances 24, 34, 44, FIG. 1; paragraph bridging pages 13-14; first to third full paragraphs on page 14) together with the coupling capacitances in each case forming a capacitive voltage divider (see, e.g., FIG. 1; second full paragraph on page 14) with the probe voltages as middle voltages of the capacitive voltage dividers (see, e.g., capacitive probes 20, 30, 40, FIG. 1; second full paragraph on page 14), the coupling capacitances remaining uninfluenced by the target (see, e.g., paragraph spanning pages 7-8), and an evaluating device (see, e.g., evaluating device 50, FIG. 1; first and last full paragraphs on page 14) connected to the probes is provided and which enables the probe voltages to be processed to an output signal (see, e.g., output signal 52, FIG. 1) which is a measure for the position of the target object to be found.

The invention as presented in independent claim 35 provides a method for capacitive position finding of a target object (see, e.g., target object 12, FIG. 1; paragraph bridging pages 13-14), in which a plurality of capacitive probes (see, e.g., capacitive probes 20, 30, 40, FIG. 1; paragraph bridging pages 13-14; first and last full paragraphs on page 14) is arranged over a detection area in which a position of the target object is to be determined, wherein the probe voltages are dependent on the spacing of the target object from the given probe and are evaluated for determining the position of the target object (see, e.g., last full paragraph on page 14), the probes are in each case supplied with a supply voltage (see, e.g., voltage source 14, FIG. 1; paragraph bridging pages 13-14) across coupling capacitances (see, e.g., coupling capacitances 22, 32, 42, FIG.

1; paragraph bridging pages 13-14), capacitive voltage dividers (see, e.g., FIG. 1; second full paragraph on page 14) with the probe voltages as middle voltages of the capacitive voltage dividers being formed through the coupling capacitances and by the capacitances of probes to the environment (see, e.g., measurement capacitances 24, 34, 44, FIG. 1; paragraph bridging pages 13-14; first to third full paragraphs on page 14) varying as a result of a position change of the target object to be detected, and the coupling capacitances remaining uninfluenced by the target (see, e.g., paragraph spanning pages 7-8), and the probe voltages are processed with an evaluating device (see, e.g., evaluating device 50, FIG. 1; first and last full paragraphs on page 14) to an output signal (see, e.g., output signal 52, FIG. 1), which is a measure of the position of the target object to be found.

The present invention as presented in independent claim 40 provides a device for the capacitive position finding of a target object (see, e.g., target object 12, FIG. 1; paragraph bridging pages 13-14) having a plurality of capacitive probes (see, e.g., capacitive probes 20, 30, 40, FIG. 1; paragraph bridging pages 13-14; first and last full paragraphs on page 14) distributed over a detection area in which a position of the target object is to be determined, wherein a dependence of the probe voltages on the spacing of the target object from the given capacitive probe is evaluatable for position determination (see, e.g., last full paragraph on page 14), the probes are in each case connected across coupling capacitances (see, e.g., coupling capacitances 22, 32, 42, FIG. 1; paragraph bridging pages 13-14) to a voltage supply and can be supplied with a supply voltage (see, e.g., voltage source 14, FIG. 1; paragraph bridging pages 13-14),

the capacitances of probes to the environment (see, e.g., measurement capacitances 24, 34, 44, FIG. 1; paragraph bridging pages 13-14; first to third full paragraphs on page 14) together with the coupling capacitances in each case forming a capacitive voltage divider (see, e.g., FIG. 1; second full paragraph on page 14) with the probe voltages as middle voltages of the capacitive voltage dividers, the coupling capacitances remaining uninfluenced by the target (see, e.g., paragraph spanning pages 7-8), an evaluating device (see, e.g., evaluating device 50, FIG. 1; first and last full paragraphs on page 14) connected to the probes is provided and which enables the probe voltages to be processed to an output signal (see, e.g., output signal 52, FIG. 1), which is a measure for the position of the target object to be found. The plurality of capacitive probes are distributed on one side (see, e.g., first side 71, FIG. 6; first full paragraph on page 17) of a printed circuit board (see, e.g., FIG. 6) over the detection area in which the position of the target object is to be found, for forming the coupling capacitances there is at least one coupling electrode (see, e.g., coupling electrode 80, FIG. 6; first full paragraph on page 17) on a facing side of the printed circuit board by means of which coupling electrode a supply voltage (see, e.g., voltage source 14, FIG. 1) can be coupled onto the probes and the printed circuit board for forming a coupling layer (see, e.g., coupling layer 72, FIG. 6; last full paragraph on page 17) is at least partly made from a dielectric material.

GROUNDS OF REJECTION TO BE REVIEWED ON APPEAL

(1) Whether claims 19-40 are unpatentable under 35 U.S.C. 112, first paragraph, for failing to comply with the written description requirement.

(2) Whether claims 19-40 are unpatentable under 35 U.S.C. 103(a) over Lambert (6,724,324), Kawahara (6,462,563), and Eichelberger (4,290,052).

ARGUMENT

(1) Rejection of claims 19-40 under 35 U.S.C. 112, first paragraph.

The Examiner asserts that the claims contain subject matter which is allegedly not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventors, at the time the invention was filed, had possession of the claimed invention. Specifically, the Examiner alleges that the term "middle voltages" in claims 19, 35, and 40 lacks antecedent basis in the disclosure originally filed with the application and that it is not clear what is intended by the term "middle voltages." (Final Office Action at page 2). To this extent, the Examiner argues that the term "middle voltages" constitutes new matter.

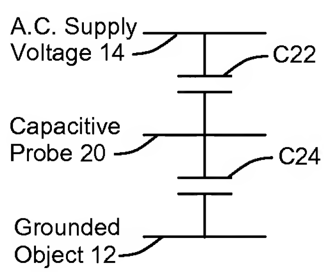
Appellants disagree and submit that the Examiner has misinterpreted the invention as disclosed and claimed by Appellants.

Independent claim 19 (similarly independent claims 35 and 40) includes the feature of "the capacitances of probes to the environment together with the coupling capacitances in each case forming a capacitive voltage divider with the probe voltages as middle voltages of the capacitive voltage dividers." Appellants

submit that term “middle voltages” included in this feature is clearly and completely disclosed and described in the disclosure as filed.

The device 10 of the present invention includes a plurality of capacitive voltage dividers as depicted in FIG. 1 and described, for example, on page 13, line 17 through page 14, line 18 of the disclosure as filed. A first capacitive voltage divider is formed by coupling capacitance 22, measurement capacitance 24, A.C. supply voltage 14, and object 12 which can, e.g. be grounded. Additional capacitive voltage dividers are formed by coupling capacitance 32 and measurement capacitance 34, and by coupling capacitance 42 and measurement capacitance 44.

The voltage divider formed by coupling capacitance 22 (C22), measurement capacitance 24 (C24), A.C. supply voltage 14, and grounded object 12, includes a capacitive probe 20 as shown in the following figure:



As known in the art, and as disclosed on page 14 of the disclosure as originally filed, the voltage (U20) on the capacitive probe 20 of such a capacitive voltage divider comprises a voltage that falls in-between the A.C. supply voltage (U0) and ground and that is given by the formula: $U20 = U0 * 1/(1+C24/C22)$.

The voltage U20 on the capacitive probe 20, which is dependent on the ratio of the capacitances, always has a value that is less than the A.C. supply voltage U0 and higher than ground. To this extent, the voltage U20 on the capacitive probe 20 comprises an “intermediate voltage” or “middle voltage” having a value that is in-between the A.C. supply voltage and ground (“intermediate” and “in-between” being accepted definitions of the term “middle”). Appellants submit, therefore, that one skilled in the art would clearly understand what is intended by the term “middle voltages” with regard to the operation of a capacitive voltage divider. Appellants further submit that it is not necessary that the exact wording from the claims be found in the specification as the Examiner appears to require, but rather “… claim limitations must be supported in the specification through express, implicit, or inherent disclosure.” MPEP 2163(I)(B).

Accordingly, Appellants request withdrawal of the rejection under 35 U.S.C. 112, first paragraph.

(2) Rejection of claims 19-40 under 35 U.S.C. 103(a) over Lambert (6,724,324), Kawahara (6,462,563), and Eichelberger (4,290,052).

Appellants submit that the rejection of claims 19-40 under 35 U.S.C. 103(a) is defective because, *inter alia*, the references of Lambert, Kawahara, and Eichelberger, taken alone or in any combination, fail to disclose each and every feature of the claims.

The present invention relates to a device and a method for the capacitive position finding of a target object.

The present invention relates to the provision of coupling capacitances which, together with capacitive probes, in each case form capacitive voltage dividers. The capacitances of the probes with respect to the environment and the coupling capacitances in each case forming a capacitive voltage divider, with the probe voltages as the middle voltages of the capacitive voltage dividers. (Specification at page 14, second full paragraph; FIG. 1).

In accordance with the present invention, while the measurement capacitances are influenced by an approaching target, the coupling capacitances **remain uninfluenced** by the approaching target. (Specification at paragraph spanning pages 7 and 8; independent claims 19, 35, 40). Thus, according to the invention and unlike the prior art, there is not a direct supply to the capacitive probes, which can also be referred to as measuring probes. Instead, a voltage divider is built up via the coupling capacitances and the measuring capacitances.

Further, unlike Lambert, where the term coupling capacitances is understood to mean a capacitance, the coupling of which is varied by an approaching object, the term "coupling capacitances" in accordance with the present invention is understood to mean a "coupling in" capacitance. (Specification at page 7, fifth full paragraph). Thus, it is the capacitance by means of which the AC voltage is coupled onto the measuring probe.

Appellants agree with the Examiner that neither Lambert nor Kawahara disclose a voltage divider with a coupling capacitance that remains uninfluenced by an approaching target. (Final Office Action at pages 3-4).

Kawahara teaches an array of a plurality of electrodes which are arranged in lines in x- and y-direction, respectively. Information on the position of a target, in particular a finger of a user, can be obtained be measuring the mutual capacitance of, e.g., the x(i)-electrode versus the y(j)-electrode. (Kawahara at column 4, lines 7 to 55). In fundamental contrast to this principle of measurement, the present invention uses a coupling capacitance for coupling a measurement signal to a capacitive probe and the probe voltage, which is sensitive to an approaching target, is subsequently processed to obtain information on the localization of the target.

The Examiner argues that Eichelberger remedies the glaring deficiencies of Lambert and Kawahara. (Final Office Action at page 4).

Eichelberger discloses a capacitive "touch-panel" wherein, by means of an electrode 18b, a signal is coupled to an electrode 18a. (Eichelberger at FIG. 1b). Based on a capacitance C_T, which is changed by the touch of a finger, a signal is coupled on a receiving electrode 18c, again by means of the electrode 18b. (*Id.* at FIG. 1b, column 4, lines 5-34).

One fundamental difference between the present invention and Eichelberger is that no **middle** voltage of the capacitive voltage dividers constituted by the capacitances C_R and C_T, and C_{RC}, and C_T, respectively, is being evaluated and measured by Eichelberger. To this extent, even assuming, *arguendo*, that the combination of Lambert, Kawahara, and Eichelberger is proper, the resultant combination still fails to disclose each and every feature set forth in independent claim 19 (see also independent claims 35 and 40).

The Examiner further argues that a person skilled in the art would be motivated to modify a combination of Lambert and Kawahara in view of Eichelberger insofar that the coupling capacitance 22 in the configuration of Lambert would **remain uninfluenced** by an approaching target. (Final Office Action at page 4). Appellants disagree.

The change in the measured coupling capacitance C_{AB} 22, when an object approaches, is an essential and fundamental part of Lambert's invention. (Lambert at column 3, lines 20-52; FIGS. 1 and 2). In particular, Lambert discloses that when a person's hand 20 approaches the electrodes, the measured capacitance C_{AB} 22 decreases. (*Id.*). To this extent, one skilled in the art would not abandon this principle and use a completely different principle of measurement, such as the one disclosed by Eichelberger. This would require a complete redesign of Lambert's invention.

Appellants further submit that, contrary to the Examiner's assertions, Eichelberger does not unambiguously disclose that the coupling capacitance C_{TR} is uninfluenced when the touch panel is touched by a finger. Although Eichelberger discloses that the coupling capacitance C_{TR} is a function of the area of the transmitting electrode 18b, the thickness T and the dielectric constant of the insulative layer 16, Eichelberger does not disclose that these are the "only" factors that may influence the value of the coupling capacitance C_{TR}. (Eichelberger at column 3, lines 60-68). Thus, the Examiner's assertion that the coupling capacitance C_{TR} is a function "only" of the area of the transmitting

electrode 18b, the thickness T and the dielectric constant of the insulative layer 16 is unsupported and inaccurate.

Returning to Lambert, Appellants submit that Lambert does not disclose a capacitive voltage divider as argued by the Examiner. (Final Office Action at page 3). On the contrary, Lambert discloses a much different capacitive arrangement. In particular, nowhere in Lambert is there disclosed an invariant coupling capacitance, wherein the capacitances of probes to the environment together with the coupling capacitances in each case forming a capacitive voltage divider with the probe voltages as middle voltages of the capacitive voltage dividers, and wherein the probes are in each case connected across the coupling capacitances to a voltage supply and can be supplied with a supply voltage. (Independent claim 19; see also independent claims 35 and 40). Instead, Lambert discloses a network including a parasitic capacitance 22, which is positioned directly between an AC source 24 and a detector 26, and two stray capacitances 32, 34, that change when an object approaches the sensor in a rather undefined geometric area. (Lambert at FIG. 1).

The stray capacitances 32, 34 in Lambert, according to description of FIG. 13 (column 12, lines 3 to 8), are not of any relevance with respect to the principle of measurement used by Lambert. That is, Lambert fails to describe the function of a voltage divider. Rather, only the current 72 through the capacitance 22 is evaluated by operational amplifiers 116 and 74. (Lambert at column 8, lines 65 to 67).

A further difference between Eichelberger with respect to Lambert is described in column 4, lines 26-31 of Eichelberger. Specifically, Eichelberger describes a so-called “T”-structure, whereas in Lambert a “PI”-structure is described. While the assembly of electrodes may, at first glance, look similar, it also reflects the differences as compared to Lambert and the present invention. For example, in Eichelberger, two electrodes must oppose each other within the area of a third electrode, since the measurement distance is obtained by the detour via a third electrode and not by any two neighboring electrodes.

Eichelberger also fails to disclose the evaluation of a voltage. Due to the pulsed excitation used by Eichelberger, it follows that an evaluation of the time dependence of the response voltage is necessary. In other words, the decay behavior of the voltage must be observed.

Kawahara discloses a three dimensional assembly of electrodes which are driven electrostatically, i.e., not with an AC-current but rather with switched voltage levels. It is not possible to realize this with signal-feeding coupling capacitances, since the DC-impedance of a capacitance is very large. Furthermore, Kawahara does not disclose how a measurement of a plurality of capacitances can be performed statically or how such measurement results could be evaluated. In particular, Kawahara fails to disclose a “probe voltage” of any type.

In view of the above-referenced deficiencies of Lambert, Kawahara, and Eichelberger, it is clear that each reference relates to fundamentally different configurations, which one skilled in the art would not have combined in the

manner suggested by the Examiner. In particular, even an arbitrary combination of the technical teachings of Lambert, Kawahara, and Eichelberger would not lead to a feasible capacitive position sensor in accordance with the present invention.

Appellants further submit that the Examiner continues to misinterpret the teachings of the present invention. For instance, the Examiner asserts that Appellants' argument that the coupling capacitances remain uninfluenced by an approaching target is contradicted by the instant disclosure. (Final Office Action at page 8). Appellants submit that the Examiner is completely incorrect.

Appellants disclose that "the coupling capacitances and the capacitances of the probes with respect to the environment and which vary due to the variable position of the target object to be detected, in each case form capacitive voltage dividers." (Specification at page 7, third full paragraph). Appellants submit that the Examiner has misapplied the second instance of the conjunction "and" in the above-referenced feature.

Appellants are not disclosing that **both** the "coupling capacitances" **and** the "capacitances of the probes with respect to the environment" **vary** due to the variable position of the target object to be detected. Rather, Appellants are disclosing that the "coupling capacitances and the capacitances of the probes with respect to the environment … in each case form capacitive voltage dividers." That is, the capacitive voltage dividers are formed by the "coupling capacitances and the capacitances of the probes with respect to the environment." The phrase

“vary due to the variable position of the target object to be detected” applies only to the “capacitances of the probes with respect to the environment.”

Appellants submit that the principle of measurement of the invention is as follows:

An approaching target changes the measurement capacitances (reference numerals 24, 34, 44 in FIG. 1), which are formed by the capacitive probes (reference numerals 20, 30, 40 in FIG. 1) relative to the environment. As a consequence, the middle voltages of the capacitive voltage dividers, which are the same as the voltages of the capacitive probes, are changed.

The coupling capacitors (reference numerals 22, 32, 42 in FIG. 1), however, remain unchanged by the approaching target. The implication of the Examiner that "something must change" to obtain a useful measurement is indeed correct. With the current invention, while the measurement capacitances change, the coupling capacitances do not.

This is an important difference with respect to the teachings of Lambert.

Accordingly, Appellants submit that independent claims 19, 35, and 40, and their corresponding dependent claims, are allowable.

With respect to the dependent claims, Appellants herein incorporate the arguments presented above with respect to the independent claims from which the claims depend. The dependent claims are believed to be allowable based on the above arguments, as well as for their own additional features.

CONCLUSION

Appellants submit that claims 19-40 are allowable because, *inter alia*, the references of Lambert, Kawahara, and Eichelberger, taken alone or in any combination, fail to disclose each and every feature of the claims as required by 35 U.S.C. 103(a).

Respectfully submitted,

/ John A. Merecki /

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CLAIMS APPENDIX

19. Device for the capacitive position finding of a target object

having a plurality of capacitive probes distributed over a detection area in which a position of the target object is to be determined,

wherein

a dependence of the probe voltages on the spacing of the target object from the given capacitive probe is evaluatable for position determination,

the probes are in each case connected across coupling capacitances to a voltage supply and can be supplied with a supply voltage, the capacitances of probes to the environment together with the coupling capacitances in each case forming a capacitive voltage divider with the probe voltages as middle voltages of the capacitive voltage dividers, the coupling capacitances remaining uninfluenced by the target, and

an evaluating device connected to the probes is provided and which enables the probe voltages to be processed to an output signal, which is a measure for the position of the target object to be found.

20. Device according to claim 19,

wherein

the coupling capacitances are at least partly constructed as discrete capacitors.

21. Device according to claim 20,

wherein

at least one of the probes is constructed as a reference probe.

22. Device according to claim 19,

wherein

the probes are distributed over a three-dimensional detection area.

23. Device according to claim 19,

wherein

the evaluating device for each probe has a rectifier.

24. Device according to claim 19,

wherein

the evaluating device has a microprocessor.

25. Device according to claim 24,

wherein

the evaluating unit has a multiplexer by means of which the probe signals of at least two probes can be supplied to the central processing unit.

26. Device according to claim 24,

wherein

the evaluating device has a signal processor for pre-processing the analogue probe signals.

27. Device according to claim 19,

wherein

the plurality of capacitive probes are distributed in a first area of a support over the detection area in which the position of the target object is to be found,

for forming the coupling capacitances there is at least one coupling electrode in a second area of the support by means of which coupling electrode a supply voltage can be coupled onto the probes and

the support for forming a coupling layer is at least partly made from a dielectric material.

28. Device according to claim 27,

wherein

the plurality of capacitive probes are distributed on one side of the support and

the at least one coupling electrode is arranged on a facing side of the support.

29. Device according to claim 27,

wherein

the support is constructed as a printed circuit board.

30. Device according to claim 27,

wherein

the support is constructed as a flexible printed circuit board.

31. Device according to claim 27,

wherein

at least parts of evaluating electronics are placed on the support.

32. Device according to claim 27,

wherein

for forming a unitary potential surface the coupling electrode is constructed as a continuous metallic layer.

33. Device according to claim 27,

wherein

further metal layers are provided for shielding.

34. Device according to claim 27,

wherein

further metal layers are provided for at least one of receiving circuit components on said support and receiving circuit components in said support

35. Method for capacitive position finding of a target object,

in which a plurality of capacitive probes is arranged over a detection area in which a position of the target object is to be determined,

wherein

the probe voltages are dependent on the spacing of the target object from the given probe and are evaluated for determining the position of the target object,

the probes are in each case supplied with a supply voltage across coupling capacitances, capacitive voltage dividers with the probe voltages as middle voltages of the capacitive voltage dividers being formed through the coupling capacitances and by the capacitances of probes to the environment varying as a result of a position change of the target object to be detected, and the coupling capacitances remaining uninfluenced by the target, and

the probe voltages are processed with an evaluating device to an output signal, which is a measure of the position of the target object to be found.

36. Method according to claim 35,

wherein

at least one of a discrete object, a liquid and a bulk material is detected.

37. Method according to claim 35,

wherein

all the coupling capacitances are supplied with the same supply voltage with a given frequency.

38. Method according to claim 37,

wherein

the quotients of several probe voltages are formed for evaluating the probe signals.

39. Method according to claim 35,

wherein

the signal voltage of at least one reference probe is taken into account during evaluation.

40. Device for the capacitive position finding of a target object

having a plurality of capacitive probes distributed over a detection area in which a position of the target object is to be determined,

wherein

a dependence of the probe voltages on the spacing of the target object from the given capacitive probe is evaluatable for position determination,

the probes are in each case connected across coupling capacitances to a voltage supply and can be supplied with a supply voltage, the capacitances of probes to the environment together with the coupling capacitances in each case forming a capacitive voltage divider with the probe voltages as middle voltages of the capacitive voltage dividers, the coupling capacitances remaining uninfluenced by the target,

an evaluating device connected to the probes is provided and which enables the probe voltages to be processed to an output signal, which is a measure for the position of the target object to be found,

the plurality of capacitive probes are distributed on one side of a printed circuit board over the detection area in which the position of the target object is to be found,

for forming the coupling capacitances there is at least one coupling electrode on a facing side of the printed circuit board by means of which coupling electrode a supply voltage can be coupled onto the probes and the printed circuit board for forming a coupling layer is at least partly made from a dielectric material.

EVIDENCE APPENDIX

No evidence has been submitted.

RELATED PROCEEDINGS APPENDIX

There are no related proceedings.